Archiving in Minnesota: System Model and Implementation

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Outline

- TDRL Introduction
- Centralization of Data
- Data hierarchies
- TDRL archive structure
- Conclusion

Transportation Data Research Laboratory (TDRL)

- TDRL is a part of NATSRL along with ASRL (Advanced Sensor Research Laboratory) at the University of Minnesota Duluth.
- Established to provide on-line ITS data resources for Minnesota
- TDRL focuses on research issues concerning large-scaled transportation data.

Sun
microsystems

S PROJECT
Neural Networks
Networks
Neural Networks

TDRL Data Model: Distributed Computing Model

- Centralization of data
- Decentralization (distribution) of computing

Advantages of Centralization of Data

- Efficient single point management
- Unified data format
- Consistent version control
- Large scale data warehousing by experts
- Efficient archiving and sharing
- Large scale data analysis

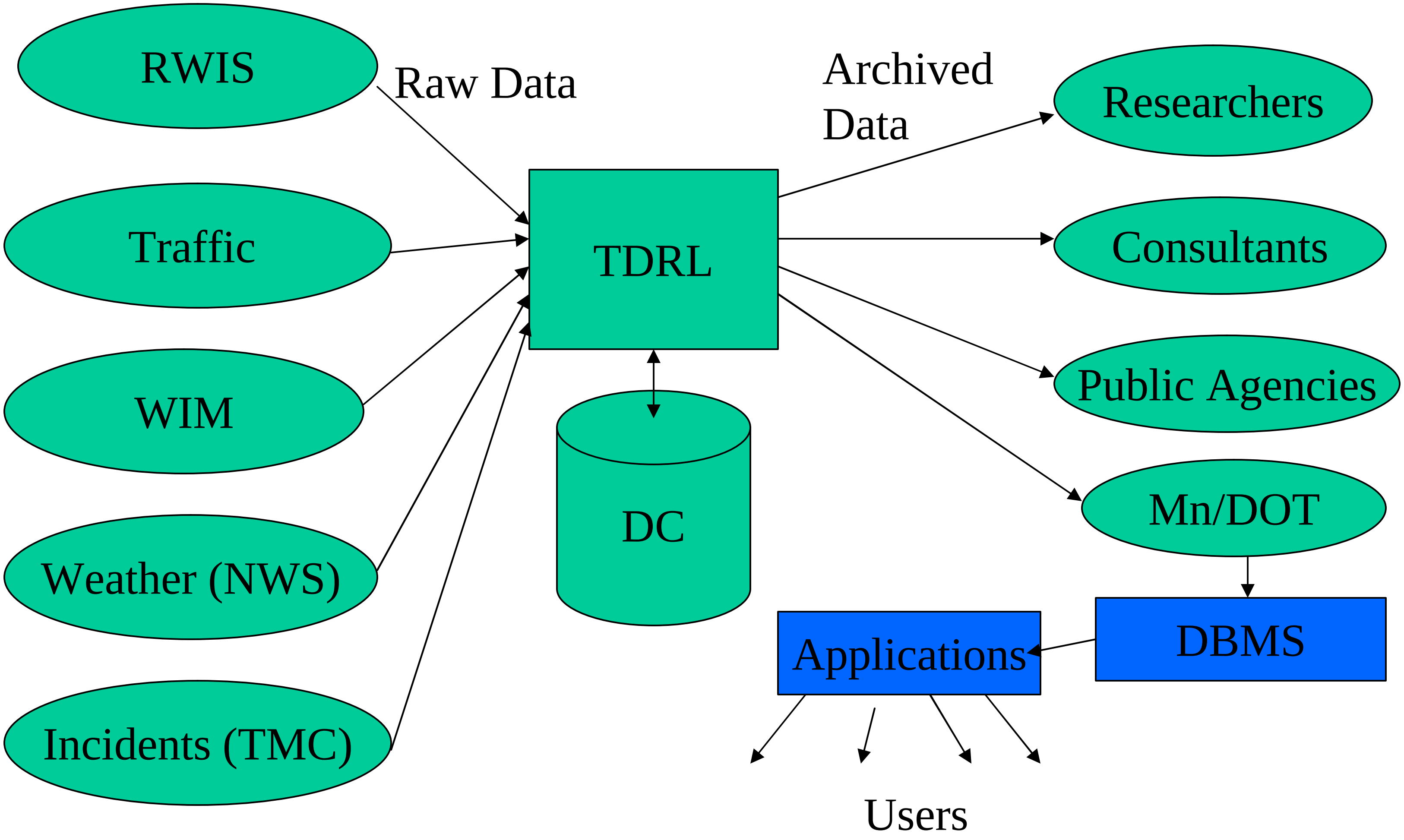
Advantages of Centralization of Data, Cont.

- Minimization of redundant efforts
- Efficient data integration and organization
- Secure archives (file backup, UPS, firewall)
- Easy cross reference and analysis
- Minimization of confusion in data
- Single point unified data quality control
- Advanced data application developments

Advantages of Centralization of Data, Cont.

- Easy and cheaper to upgrade computers
- Easy to maintain new versions of software
- Maximize data sharing among departments, public, and private sectors
- Easy to obtain user feedback and analyze
- Specialize data help
- Easy access of data

On-Line Data Source/Supply

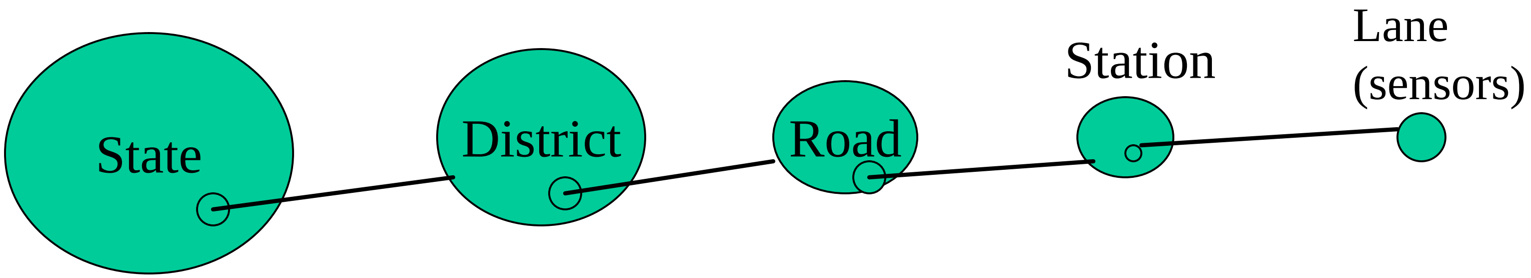


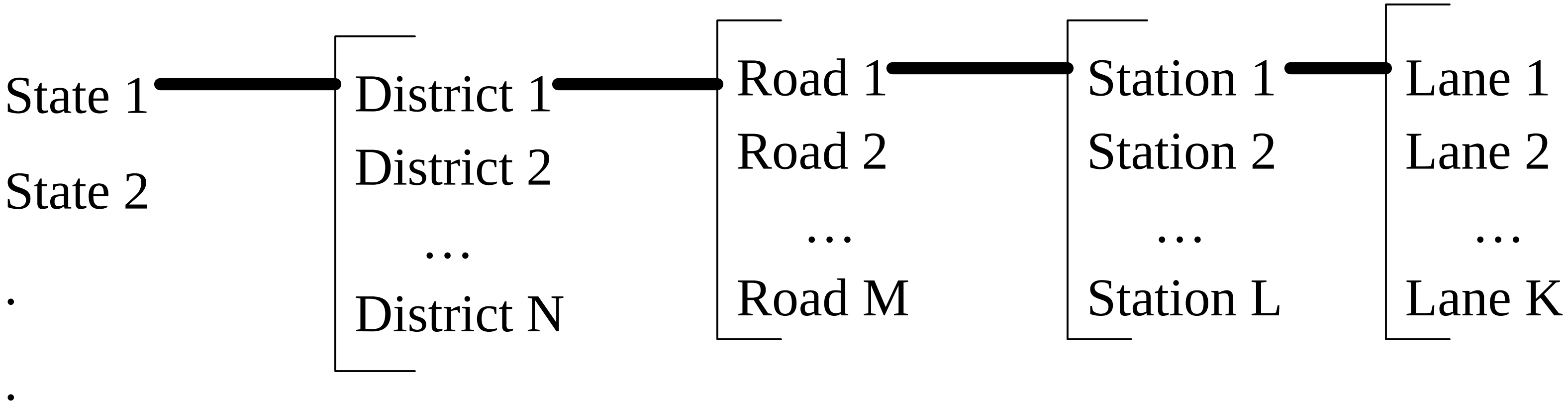
Large Scaled ITS Data Archiving

- Centralize it (It should never be tried by individuals using their desktop PCs.)
- Allocate financial, material, and human resources
- Start with a strong commitment: Archiving can never be stopped, if started.
- Analyze data characteristics and all logistics before archiving

Data Hierarchies

Spatial Hierarchy





State 1
State 2
.
.

District 1
District 2
…
District N

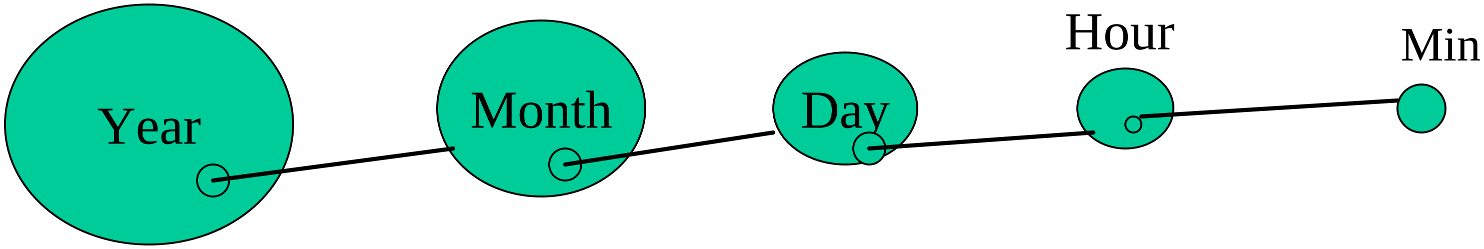
Road 1
Road 2
…
Road M

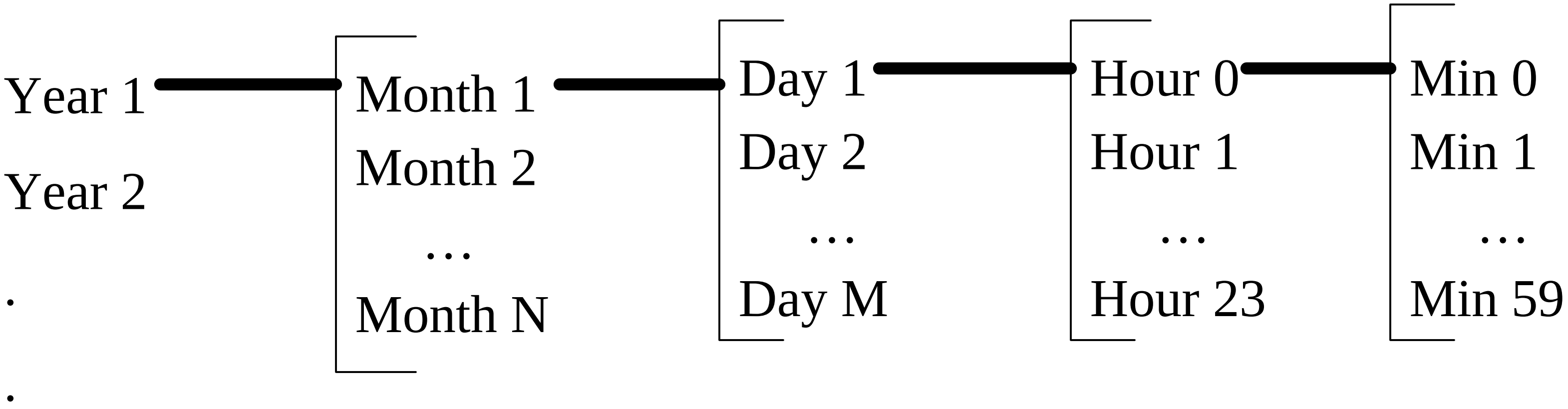
Station 1
Station 2
…
Station L

Lane 1
Lane 2
…
Lane K

Data Hierarchies, Cont

Temporal Hierarchy





Year 1
Year 2
.
.

Month 1
Month 2
…
Month N

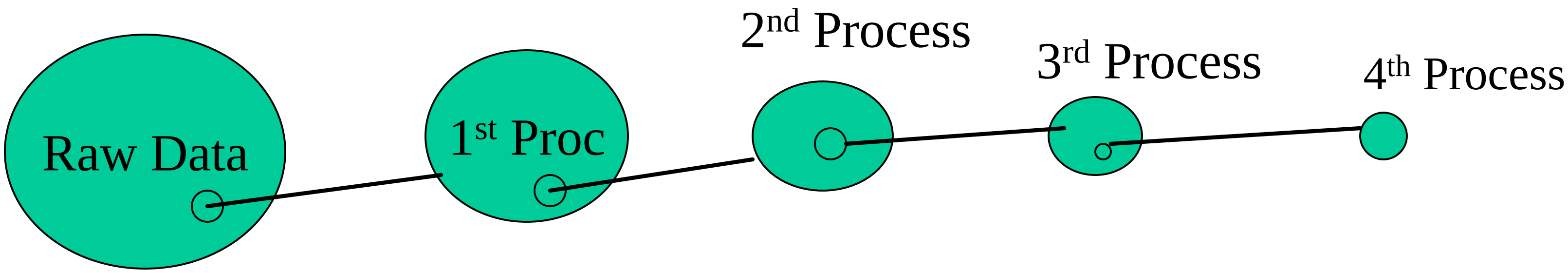
Day 1
Day 2
…
Day M

Hour 0
Hour 1
…
Hour 23

Min 0
Min 1
…
Min 59

Data Hierarchies, Cont

Computational Hierarchy



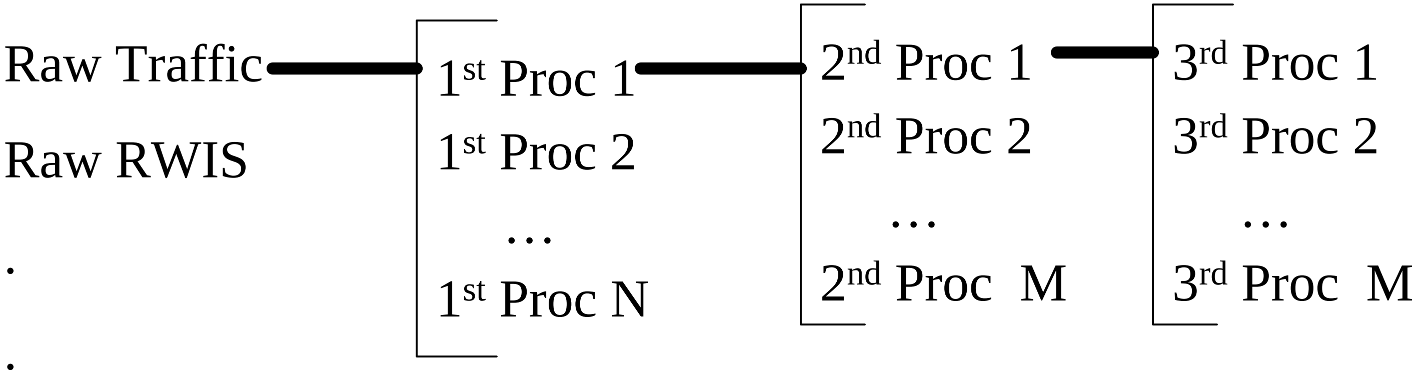
Raw Data

1st Proc

2nd Process

3rd Process

4th Process



Raw Traffic

Raw RWIS

.

.

1st Proc 1

1st Proc 2

…

1st Proc N

2nd Proc 1

2nd Proc 2

…

2nd Proc M

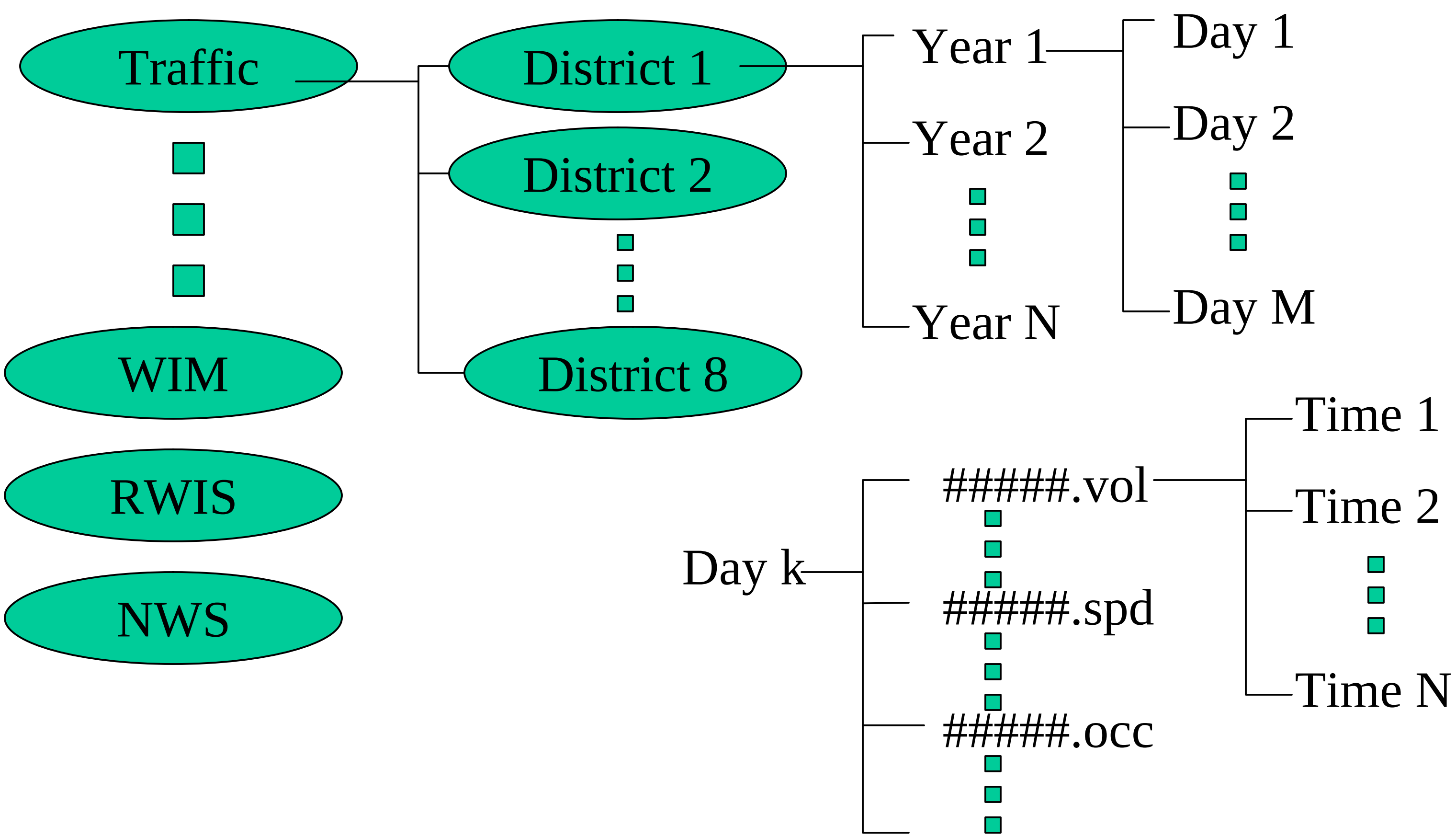
3rd Proc 1

3rd Proc 2

…

3rd Proc M

TDRL Archive Hierarchy Model



Raw Data Archiving

- Most important and critical step
- Collect data at the smallest time scale (highest sampling rate) as possible
- Try to achieve never fail robustness; real-time data can never be reproduced once it is lost. Called Write Once Read Many (WORM) data

Archiving Choices

- Binary (or Text) Zip Compressed Files
- CDF, HDF
- RDBMS

Desirable Properties of ITS Data Archive

- Small Size
- Fast Retrieval
- Portable Between Different OS
- Low Initial Investment and Maintenance Cost
- Metadata Capability
- Open Standard

Common Data Format (CDF)

- Developed for NASA Climate Data System at National Space Center Data Center
- Self-describing data abstraction for the storage and manipulation of multi-dimensional data (metadata)
- Transparent data format
- Transparent data compression
- Efficient sparse record handling
- Platform Independent
- API available in C, FORTRAN, Java, and Pearl

Conclusions

- Once archiving is started, it can never be stopped or failed. You must have a robust plan.
- Before starting archiving ITS data, every possible scenario must be reviewed
- Archiving data models need further study
- Large scaled data archiving is a challenging task requiring resources. It should not be considered as light tasks